BULLETIN of The GEORGIA ACADEMY of SCIENCE

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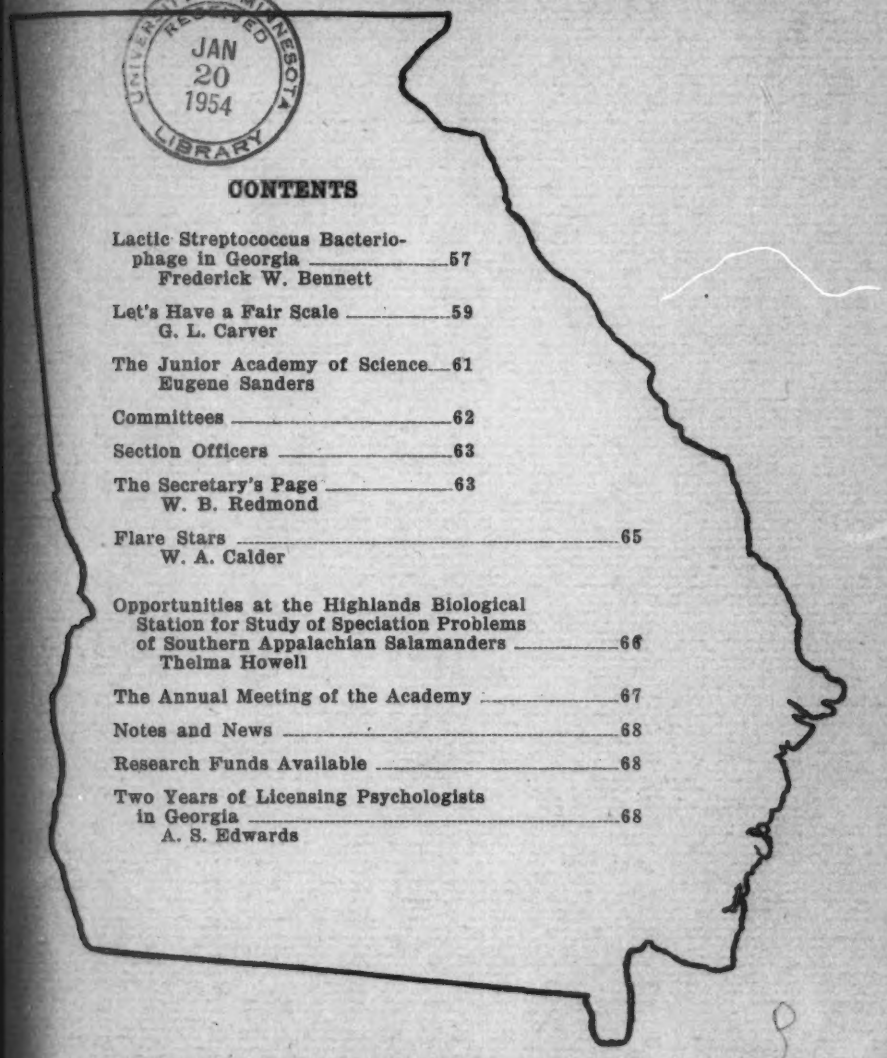

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THE BULLETIN of the GEORGIA ACADEMY OF SCIENCE is published four times each year, in April, June, September and December and is sent without charge to all members of the Academy.

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LACTIC STREPTOCOCCUS BACTERIOPHAGE FOUND IN GEORGIA

Frederick W. Bennett
The University of Georgia College of Agriculture Experiment Station

One of the common and often costly annoyances in the manufacture of dairy products such as cultured buttermilk or some of the cheeses is an occasional slow increase or complete stoppage in acid development by the essential bacteria. The acid normally is produced in most of these products by *Streptococcus lactis* or *Streptococcus cremoris*. Milk from infected udders, the presence of chemical preservatives or antibiotics, or competition from the growth of other kinds of bacteria which may be present as contaminants have been known for a long time as possible causes of delays in the action of the desirable organisms. However, in many cases none of these causes seemed to adequately explain the delays.

The lead to the discovery of another factor was found by Hammer (1933) at the Iowa Agricultural Experiment Station. He reported that the addition of cultures that had coagulated slowly resulted in delay of acid coagulation of sterile or pasteurized milk by normal cultures. Whitehead and Cox (1935) in New Zealand found the fundamental cause of such an effect to be bacteriophage which affected lactic streptococci. This was another type of transmissible agent causing destruction of bacteria which was discovered by Twort (1915) and d'Herelle (1917), described first as being particles of submicroscopic size and believed by many to be inanimate matter. The particles later were called bacterial viruses or bacteriophage and presently are considered generally to be living organisms.

Lactic streptococcus bacteriophage has been most troublesome in cheese factories in New Zealand but has been reported many times in England, Canada and the Midwestern states of the United States. Here and there evidences of the presence of the phage in the Southeastern states have been observed, but it had not been reported as being identified definitely in commercial dairy plants in this area until December 1952. At that time a commercial dairy plant in Georgia reported that normal acidity failed to develop in some skim milk set for making cottage cheese. Several vats of skim milk had been lost completely from this cause. At the same time another plant had failed to obtain satisfactory coagulation in skim milk from the first plant when it was set for making cultured buttermilk.

Samples of the laboratory culture which was used for inoculation of the skim milk, some bulk culture and curd which had been obtained in attempts to make cottage cheese were brought from the dairy plant to the Dairy Laboratory at the University of Georgia. Sterile milk inoculated with the laboratory culture coagulated normally upon incubation. Other sterile milk from the same lot failed to coagulate within the normal time when inoculated with an equal proportion of the same culture plus either a small amount of the bulk culture or whey from the affected curd. The latter lot did contain many bacteria, as shown by microscopic examination, and, after incubation for an additional day or two, finally coagulated.

Several isolations of bacteria were made by plating some of the laboratory culture on an agar medium. Each of the cultures isolated was used to inoculate a separate pair of tubes of litmus milk. Whey from the affected curd was filtered through sterile paper and then through a sterile No. 03 Selas microporous porcelain filter to remove the bacteria. A small amount of the filtered whey was added to one of each pair of the inoculated tubes. From this group of tests cultures were selected which coagulated the milk on overnight incubation at 32° C. without the added whey but failed to coagulate the milk containing the added whey.

One ml. of one of these selected cultures and 1 ml. of the filtered whey were added to 100 ml. of sterile milk and incubated at 32° C. for 6 hr. The milk then was treated with a sufficient quantity of sterile 10 per cent solution of lactic acid to coagulate the milk. The whey obtained was filtered through sterile paper and through a sterile No. 03 Selas microporous porcelain filter.

A flask with 100 ml. of sterile milk was inoculated with 1 ml. of the pure culture and designated Lot A. Another flask was prepared in the same manner, 1 ml. of the whey filtrate added and designated Lot B. Both lots of milk were incubated at 32° C. Standard plate counts of bacteria were made immediately after inoculation and after 2, 3, 4, and 5 hr. The results are shown in Table 1.

Table 1

Standard Plate Counts of Bacteria in Inoculated Milk without (Lot A) and with (Lot B) the Addition of Whey Filtrate

Hrs. after Inoc.	Lot A	Lot B
0	11,300,000 /ml.	10,100,000 /ml.
2	25,000,000	Over 30,000,000
3	73,000,000	360
4	194,000,000	1,650
5	243,000,000	4,200

Successive increases in the numbers of bacteria may be noted in Lot A without the why filtrate. The numbers of bacteria increased as rapidly in Lot B, with the whey filtrate, during the first 2 hr., but a count of only 360 per ml. was obtained at the end of 3 hr. The counts in the latter lot increased to 1,650 per ml. and 4,200 per ml. in 4 and 5 hr., respectively. Such decreases as occurred in Lot B are characteristic of the action of bacteriophage on lactic streptococci as demonstrated by Turner (1948).

Two other lots of sterile milk were inoculated and treated in the same manner. Each lot was examined microscopically by the Breed method after the same time intervals following preparation. Continuous increase in numbers of bacteria were observed in the lot without the whey filtrate but the numbers of bacteria were so small in the lot containing the whey filtrate after three hours that they were not observed under the microscope.

As the bacteria are disintegrated by the phage the development of acidity ceases rather arbuptly. If the infection is extremely light the first batch of product may be finished before complete stoppage of acid development occurs, but if a residue of phage is left in the culture or in the vat, the process may be interrupted in later batches before the final stage is reached. If more than one strain of lactic streptococci are present, acid development may not stop so abruptly but still may slow manufacturing operations sufficiently to disturb the plant routine. In the case being reported, extra strains of bacteria in the culture did not make it possible to complete the cottage cheese.

The presence of bacteriophage in the whey was demonstrated further by the production of phage plaques in dish cultures according to the technique of Turner and Nelson (1951). In the absence of phage the dish after incubation is completely covered with a growth of lactic streptococci. Serial dilutions of the whey were added with inocula of the host organism to separate dishes. Two hundred or more clear areas (plaques) each where one or more phage particles had been deposited and had lysed the bacteria, appeared on the dish containing 1/100,000 ml. of whey. This result indicated the presence of 20,000,000 or more active phage particles per ml. in the whey.

Bacteriophage particles are too small to be observed under the light microscope but have been observed and photographed by the use of electron microscopes. Such pictures of lactic streptococcus bacteriphage have been made by Parmelee, Carr and Nelson (1949) at the Iowa Agricultural Experiment Station. Bacterophage particles of this type resemble miniature spermatozoa in appearance. They are about 220 millimicrons long, have a head diameter of 70 millimicrons and a tail that is about 30 millimicrons wide and 150 millimicrons long.

Each strain of phage of this type will attack only one, or a very small number, of strains of lactic streptococci. Some strains of bacteriophage are parasitic upon certain strains of the bacteria, but do not lyse them. In some cases, certain strains of phage apparently have become so adapted that they have lysed strains of bacteria which at first were not susceptible to the particular strains of phage. A very small proportion of the individual bacteria in an apparently pure strain of the host bacteria may survive an attack of the phage, presumably because of variations in individuals. This is a probable explanation of the 360 bacteria per ml. remaining in the phage-infected culture after 3 hrs. incubation which were mentioned above. Bacteriophage reproduces only upon

its own specific living host bacteria but may exist in a dormant state for months in the absence of its host.

Attempts to prove spontaneous generation of bacteriophage have failed. Phage may be carried in milk cans, other utensils, equipment; on the feet, hands or clothing of persons; in infected dairy products, dust, livestock to which infected products have been fed, in the air or in any other manner by which bacteria may be carried. Phage has been particularly troublesome in cheese factories from which infected whey was returned to the farms of the milk producers in their milk cans. The cans, when not perfectly sanitized, had added the phage to the milk which was delivered later to the plant.

Bacteriophage generally is more resistant to adverse conditions or destructive agents than are their host organisms. The usual pasteurization of milk will not destroy lactic streptococcus phage. Temperatures of 74° C. or higher for 10 to 30 min. are required to inactivate it. It is susceptible to some chemical germicides. On the basis of research on this subject the writer (1950) recommended finely atomizing 1 g. of available chlorine from a hypochlorite solution per 1,000 cu. ft. of air space for the destruction of air-borne phage. A final rinse containing 100 ppm. of available chlorine from hypochlorite or 200 ppm. of a quaternary ammounium compound equal in effectiveness to alkyldimethylbenzylammonium chloride was recommended for the destruction of phage on cleaned surfaces. Quaternary ammonium compounds were not found practical as fine mists and glycols were ineffective when applied either as fine mists or as liquids.

Propagating the mother cultures in a laboratory which is isolated and protected as much as possible from plant operations is a good precautionary measure against phage. In case phage infection does occur, the plant and laboratory should be cleaned scrupulously and disinfected immediately, a culture of another strain obtained and care taken to prevent re-infection. If and when the phage is completely eliminated from the plant, the use of the original strain of culture may be resumed, if desired.

It is probable that lactic streptococcus bacteriophage is distributed more widely than is realized. As the number of dairies supplying each of our processing plans increases and as the transfer of milk and its products is more frequent or from greater distances, the possibility of phage trouble is increased.

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LET'S HAVE A FAIR SCALE

G. L. Carver
Mercer University

Scientists desire progress in all related fields to be as nearly equal as practical. When there is a lag in discoveries in border problems good judgment directs special attention to these discrepancies. Scientists also believe in accuracy, honesty, fairness, and education as well as progress. Violation of any or all of these factors calls for study, solution, and correction, especially if public welfare is concerned with these scientific of semi-scientific matters.

For many reasons I have been interested in the timber resources of our country and especially with those of Georgia. A few years ago fires

destroyed or devastated annually millions of acres of our younger and older timber stands. Today this senseless destructive burning is mainly eliminated or controlled by County and State fire protection units and their equipment. Progress in selective cutting, seedling planting, increased used of wood, etc., have made the twenty-four million acres of Georgia forest land potential wealth undreamed of a few years ago.

Where then is the lag in progress and what needs the attention of our Georgia Scientists?

Plainly stated; a change in the customary scale of measurement used in purchasing timber in the logs or in the standing tree needs correcting to one that is more nearly in keeping with the actual number of board feet purchased. The Doyle Scale which is now commonly used was accurate enough in the old days when the original growth of trees in Georgia was 25 inches or above in diameter. Today the small saw mill operators are cutting trees as low as 10 inches and even 8 inches in diamter at the base. I am told that in certain sections even 7 inch trees are cut for saw timber. These smaller trees give to the timber buyer an average 25% to 35% more lumber sawed out than the volume paid for to the timber owner. It is as though you went to the lumber retailer and told him you would take 1,350 board feet of lumber but would pay him for only 1,000 feet. Is it as simple as that, you ask?

Study the following tables for comparison. The volume sawed out by Scribner Decimal rule allows for some defective trees, poor machinery, and some mistakes of the sawyer. With good trees, good machinery, and a good saw-mill operator the lumber cut out will correspond to the International Scale. The following is an official comparison. Only enough of each table is given to prove the issue. Complete tables can be given if desired.

Comparison of Log Rules Most Commonly Used

All A+ 16-Foot Logs

Diameter (small end inside bark)	Doyle	Scribner	International
6	4	20	20
8	16	30	40
10	36	60	65
12	64	80	95
14	100	110	135
16	144	160	180
18	196	210	230
20	256	280	290
22	324	—	355
24	400	—	425

Tree Scale — Doyle Rule

Diameter breast high Inches	No. of 16-foot logs				
	1	2	3	4	5
10	16	25	—	—	—
12	31	54	70	—	—
14	49	89	112	—	—
16	76	134	165	188	—
18	110	190	230	260	—
20	140	240	310	360	—
22	180	310	410	470	—
24	220	400	530	600	640
26	280	510	670	760	810
28	330	620	820	920	1,010
30	390	750	970	1,090	1,210

Tree Scale — International ¼-inch Rule

Inches					
	1	2	3	4	5
10	40	65	—	—	—
12	60	105	145	—	—
14	80	150	195	220	—
16	110	200	260	285	—
18	140	250	330	380	—
20	180	320	420	480	—
22	220	390	520	600	—
24	260	480	630	730	810
26	310	580	760	880	1,000
28	360	690	910	1,050	1,190
30	430	810	1,070	1,220	1,410

A glance at the tables will show the great discrepancies between say the Doyle and the International especially when the timber is of small diameter. For example—a 16 foot log 8 inches in diameter at the small end by Doyle is 16 board feet; by International more than double or 40 board feet. A 12 inch log by Doyle 49 board feet; by International 95 board feet. A 12 inch tree, diameter breast high, with three logs by Doyle is 70 board feet; by International 145. Again more than 100% difference. A 16 inch tree, diameter breast high, with 4 logs by Doyle gives 188 board feet; by International 285. As previously mentioned the sawyer with a good mill and good trees can saw out the International Scale. One well-known lumberman told me that if he were on the job to supervise the cutting he could even exceed the International by 10%. The accuracy of this as-

sertion may be questioned, and, of course, I have no way of proving it.

A bill was submitted in the last State Legislature recommending the legal adoption of either the Scribner Decimal or International Scale. It was not passed. I hope the bill will be re-submitted and will meet with the approval of the legislators.

One could also feature in an article the need for correcting the common custom of lumbermen when unrestrained by contract of cutting off all large trees without leaving a single seed tree on the cut-over area. They should be educated to the point of leaving one to five good seed trees per acre on any tract of timber they may be allowed to harvest. Millions of acres of Georgia's land have been devastated of all seed trees, fire destroying the young pine leaving land in possession of the scrub oak and other worthless vegetation. These two points mentioned are to me very important and need as early correction as possible.

THE JUNIOR ACADEMY OF SCIENCE

Eugene Sanders, Director

I. **WHAT IT IS:** The Junior Academy of Science is an organization of high school boys and girls in science clubs throughout the state of Georgia.

II. **WHO SPONSORS IT:** The Junior Academy is sponsored by the Georgia Academy of Science. It is a major activity of the Georgia Academy, which maintains close contact with the Junior Academy, helping to support it both financially and through the leadership and efforts of its own members. The president of the Academy of Science appoints the Director of the Junior Academy of Science, and also a liaison committee to aid the Junior Academy and maintain contact with the senior organization.

III. **WHAT THE JUNIOR ACADEMY DOES:** The Junior Academy of Science is now carrying on four major activities:

1. **Science Clubs.** Through its State Chairman, Mrs. Howard Burnette, the Junior Academy of Science organizes science clubs in high schools throughout the state.

These science clubs are the heart and soul of this movement. They provide the opportunity for the pupil interested in science to follow his interest and to develop his scientific ability under the guidance of a teacher who is willing to give a little more time and effort that science may be advanced and the pupils interest directed and increased.

The need for science teachers to organize these clubs with Mrs. Burnette's help and to sponsor them is the most pressing need in our program. Members of the Georgia Academy of Science who are also teachers in the secondary schools of the state are urged to respond to this need and opportunity.

2. **State Science Talent Search.** The Junior Academy of Science, with Miss Elise Sherrill, as State Chairman, conducts a State Science Talent Search in connection with the Westinghouse Science Talent Search. Pupils entering the Westinghouse Science Talent Search are entered automatically in the State Science Talent Search. Senior high school students interested in this competition should make arrangements at once to take part.

3. **State Science Fair.** A State Science Fair, under the direction of State Fair Chairman, Mr. Richard N. Jones, affords the special kind of competition so necessary to achievement. The first three annual state fairs were held at Emory University, the others at Oglethorpe University. The Sixth Annual State Science Fair will be held at Oglethorpe University in Atlanta April 15, 16, 17, 1954.

This spectacular display of work done by high school students in the state during the current school year is the crowning event of the Junior Academy's program. Boys and girls from all over the state come together for three days on Oglethorpe's campus, visit other institutions, such as Emory University, Agnes Scott College, and Georgia Tech, as well as the many other interesting and educational places in Atlanta, with enriching experiences in social and scientific activities.

Pupils throughout the state are urged to begin their projects and exhibits for the fair now. Write for information and make plans early.

National Science Fair. Winners in

the State Science Fair whose work is of sufficiently high quality may be selected to represent Georgia at the National Science Fair, which will be held in Purdue University. This will not only be an outstanding honor for these science students, but also the trip to Purdue will be most enjoyable as well as helpful.

Teachers are urged to supervise carefully the planning and completion of projects. The quality of work must be high for national competition.

4. **The Annual Convention.** The final event of the year's program for the Junior Academy of Science is the Annual Convention, to be held at Oglethorpe University April 17, 1954. This convention is divided into a business session for the election of officers and other routine business, the program session, and the luncheon.

5. **The Program Session.** Heretofore the most satisfying event intellectually has been the presentation of projects by the winners in the Science Talent Search. This features the program for the convention, and because of the value of the work done, the development of the students, and the stimulating nature of the convention this feature of our year's work has been highly praised.

IV. WHO ARE OUR AFFILIATES? While the Junior Academy is sponsored by the Georgia Academy of Science, it is also affiliated with Science Clubs of America, a national organization sponsored by the Westinghouse Foundation. This group is well experienced in the formation of science clubs, the conduct of Science Talent Searches, and of Science Fairs. It furnishes sponsors of clubs with a quantity of free materials for programs and activities to insure the success of a science club.

V. WHO ARE OUR OFFICERS? The Junior Academy of Science annually elects from the student members a full corps of officers.

In addition, an executive committee composed of the director, the State Chairmen, a secretary, Miss Carol Black, Avondale High School, Avondale Estates, Ga., and a treasurer, Dr. Lane Mitchell, Georgia Institute of Technology, directs the work, together with the liaison committee and the teachers sponsoring the science clubs.

Our host, for the third time, this year is Oglethorpe University which again extends its gracious hospitality to the high school boys and girls of Georgia and their teachers on this occasion.

The Junior Academy of Science is dedicated to the discovery and development of scientific ability among the youth of Georgia. We urge you to help.

VI. WHERE CAN I GET MORE INFORMATION?

For general information, write to:
Mr. Eugene Sanders, Director
1176 Ridgewood Drive, N.E.
Atlanta, Ga.

About the Science Talent Search:
Miss Elise Sherrill, State Chairman
300 Church Street
LaGrange, Ga.

About the Sixth Annual State Science Fair:
Mr. R. N. Jones, State Chairman
North Fulton High School
Atlanta, Ga.

About a Science Club:
Mrs. Howard Burnette, State Chairman
Chamblee High School
Chamblee, Ga.

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III Geology Geography	Miss Lewis Lipps Shorter College Rome, Ga.	Prof. R. J. Martin Dept. of Geology Emory Univ., Ga.
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V Psychology Medicine	Dr. Florene Young Univ. of Georgia Athens, Ga.	Miss Martha Schnebly 1183 Briarcliff Rd. Atlanta, Ga.
VI Philosophy and History of Science	Dr. G. C. Seward Oglethorpe Univ., Ga.	Dr. G. C. Seward Oglethorpe Univ., Ga.

THE SECRETARY'S PAGE

W. B. Redmond

It occurred to me that this section would give to me an opportunity to make an appeal to all members of the Academy to contribute articles for publication in the Bulletin and thus get into print. In fact I actually did begin writing such an article but it had so little appeal that I delegated it to the waste basket and decided to make another attempt on some other subject.

I am fully aware that there are many (probably a majority) members of the Georgia Academy who have little or no interest in its or-

ganization and program. Nevertheless, for a few who may consider it worth the time required to read these paragraphs I am going to discuss briefly the organization and function of the sections of the Academy.

During the early years of the Academy's existence when the membership was limited to a few representatives from each of the various fields of science there was no room for division into groups or sections. Also during this time each member (we shall assume) was interested in all aspects of science and considered it a privilege to sit patiently and listen to papers on subjects so remote from his garden of thoughts that his repose was undisturbed. Of what interest were ultrasonic vibrations to a bacteriologist? Yet his applause was just as resounding as if he were a physicist.

As the Academy members increased in number and more and more papers were presented on the annual program it began to be apparent that the only solution was to divide the program into sections. The designation of broad fields of science, and the selection of his section by each member was considered to be the most logical means of "sectioning" the Academy. Accordingly five sections were designated. In 1952 a sixth was added. Provision is made in the constitution for adding other sections as the need may arise. Any group desiring recognition as a section will be designated as such if and when a majority of the members of the particular field of science make a request to the executive council of the Academy.

Each section elects a chairman, a secretary and a representative to the council. Two of the offices may be held by one person, but not all three. The chairman and the secretary are responsible for the program of the section at the annual meeting. Requests for places on the program should be sent to the chairman of your section, or if the paper is in another field, to the chairman of that section. The chairman will arrange the papers into an integrated program which will be forwarded to the Academy secretary for publication in the Bulletin. The chairman is also requested to send to the secretary for publication a report including the outstanding events of the section program and other matters of interest to the section.

Should either of the offices of any of the sections be unfilled or be vacated it is the duty of the president to fill the office by appointment, generally after consultation with other members of the section.

Though young and of recent origin the sections are beginning to function in a manner that will in a short time make the annual meeting of the Academy the scientific event of the year. As one section strives to have a better program than the others the quality of the whole meeting will improve. This impetus will attract attention not only of the members but also of others interested in the various activities of the Academy.

Members should begin to make plans now to take part in the program of the next annual meeting. Papers presented at the annual meeting may be presented at other meetings also, if desired. Though there is no obligation on the part of the author to present his paper for publication in the Bulletin the editor would be glad to consider it. In the case of a symposium the publication of the individual papers in a group is highly desirable.

There are a few members who have not designated a section choice. Cards were mailed in 1952 to all members not listed in the sections, but a few have failed to reply. Should you be one of these (see Directory) please write the secretary giving the section of your choice. In many cases more than one section has been indicated. Unless otherwise designated by the member I have listed two or more sections for a person in numerical order. Should you have interests in sections II and IV and have so indicated, and you are primarily a physicist I shall be glad to reverse the order of the sections if requested to do so. Notify the secretary of any changes desired in the directory or in address.

The chairman and secretary of each section are listed on page 63. The council representative is listed with the officers on the inside cover.

FLARE STARS

W. A. Calder
Agnes Scott College

Mysteries are routine in astronomy, but here is a relatively new thing to ponder. We would brush it off as incredible except that the phenomenon has been observed at several times and places, and in various ways.

In the course of the parallax program at Sproul Observatory (Swarthmore) 16 photographs were made of the star Kruger 60, all within the course of an hour. Each exposure was of 135 seconds duration, after which the plate was shifted slightly for the next. The star was normal for eleven exposures but the twelfth showed that the star had brightened by two and a half times. The remaining images showed decline to nearly normal light. Another star has been found to flare on 13 occasions, on one of which the star brightened 100-fold in about a minute. That this phenomenon is actual star jitter rather than foible of the photographic emulsion was proved in the case of still another star which was followed with photoelectric cell. The sensitivity had been adjusted to allow for an increase in deflection by a factor of three, but a sudden outburst sent the needle completely off scale. Before the sensititvity could be reduced, the star had declined to near normal light. Ordinarily this star was invisible in the small finder telescope, but during the binge it was conspicuous.

About a dozen stars have shown this type of behavior. In every case, the star has been of the red dwarf type. Such objects are smaller, cooler and a thousand times fainter than our sun. They are notoriously hard to detect because they can be observed only to small distances, and are in no way distinguishable from thousands of other secks that represent stars on any photograph of the sky. Considering the effects of observational selection, it is evident that these are cosmically abundant and hence star jitters must be a common affliction. Whether it is a disease of infancy or old age is not known. Notwithstanding the assurance of certain popular writers, the course of stellar evolution is not known.

What can be the cause of these rapid fluctuations? Our own sun has frequent outbursts that strongly affect magnetic conditions and short-wave radio transmission on the earth. They are often associated with sunspots and have occasionally been visible in integrated light, although they are usually revealed only in the light of the calcium or hydrogen atom. In no case has there been a perceptible increase in the sun's flux of total radiation. It is true that an event which could increase the sun's output temporarily by 1% would brighten a dwarf by several fold if it took place on the dwarf star. Red dwarf stars have been difficult for theoretical astronomers to explain. According to their models, these small stars have deep layers of convection whereas normal stars transport their energy outward from the center mostly by radiative transfer. Red dwarfs might be expected to be very turbulent, but how could large masses of hot matter cool in a matter of minutes? A given increase in light might be produced by tiny pore exuding radiation characteristic of matter at a much lower depth. The spectrum would show great change, but unfortunately this is not easy to observe since the stars are faint and exposures of many minutes are required when the light is dispersed into the spectral band. It would be of great interest to know if this may be a source of cosmic rays. The difficulty here would not only be in the weakness of such a burst at its arrival at the earth, but also in the impossibility of correlating possible cosmic ray bursts with stellar change. Material particles would arrive at an unknown time later than the light from the outburst, and the inevitable dispersion in speed of various types of particles would completely mask their identity.

OPPORTUNITIES AT THE HIGHLANDS BIOLOGICAL STATION FOR STUDY OF SPECIATION PROBLEMS OF SOUTHERN APPALACHIAN SALAMANDERS.

THELMA HOWELL[1]
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The Highlands Biological Station is located on the Highlands Plateau, the last plateau area southward in the Appalachian mountains. It is situated, therefore, at the end of the mountain funnel which brings northern fauna and flora into close contact with southern forms. The Plateau, elevated nearly 4000 feet, is atop the southern escarpment of the Blue Ridge Mountains, and in many places one can view the piedmont areas of South Carolina and the extreme northeastern tip of the Central Upland Province of Georgia as far as the eye can see.

At this time we are interested in the strategic location of the Station because of its close proximity to sites of investigations, the findings of which have made such impacts in our changing conceptions of the speciation problem. Specifically, I refer to the Southern Appalachian salamanders of the genus *Plethodon*.

The emergence of what Huxley called "New Systematics" is beautifully illustrated in the investigations that have been done on the plethodonts in the Southern Appalachians. Between 1900-1937 the conception of the *species* as the lowest taxonomic unit was apparent in the work of Blatchley, Stejneger, Brimley, Dunn, and Walker as they respectively described *jordani*, *shermani*, *metcalfi*, *yonahlossee*, and *welleri*. Bailey (1937) pointed out some interesting variations in populations of plethodontid salamanders of the Southern Appalachians. When Bishop (1941) made *shermani* a subspecies of *glutinosus*, the "New Systematics,"—in which the species was reduced in importance and subspecies and populations became the taxonomic unit,—mades its advent in the Southern Appalachians as far as salamanders were concerned. Grobman (1944) carried the torch and was generous enough to all but pin-point likely ranges for new subspecies. Pope and Hairston (1948) had a "field day" when they took the southern segment of the *metcalfi* of Brimley and named two populations: *P. s. melaventris* from Highlands, North Carolina, *P. s. rabunensis* from Rabun Bald Mountain, Georgia. Later that year, these two investigators removed *shermani* from *glutinosus* where it had been placed by Bishop, and cal'ed it *P. s. shemani*. At the same time they made *clemsonae*, described by Brimley in 1927 from Jocassee, South Carolina, a subspecies of *shermani*. One of the investigators, Hairston (1950) made *shermani*, *clemsonae*, *rabunensis*, and *melaventris* subspecies of *jordani*, and described yet another population of *jurdani* which he called *teyahalee*.

In discussing briefly, and of necessity somewhat superficially, some of the problems of speciation that may be studied in this *jordani* group, I shall not attempt to evaluate the validity of the subspecies named above. Instead, I shall try to indicate the approaches to the more theoretical aspects of speciation that may yet be studied in these populations.

Speciation is a stage in evoluntionary divergence. We realize today that the problems of speciation involve several fields of biology: genetics, ecology, biogeography, paleontology, and systematics. These *jordani* salamanders under consideration need study from at least three of these fields: systematics, ecology, and genetics.

Let us look at the problems from the point of view of the systematist. He is dealing with a polytypic species, based on the principle of geographic variation. He views the populations in terms of whether or not the variations affect taxonomically important characters. His conventional method is to note certain kinds of group variations: (1) quantitative, expressing degree of difference, (2) qualitative, expressing the presence or absence of characters, and (3) meristic, expressing difference in numerical proportions. With those points in mind, let us entertain some suggestions as to problems. How *valid* are the morphological characters now used to separate the populations: size, color pattern, costal grooves, vomerine teeth, etc.? If these characters are *good*, are they correlated with any other characters? Are there other morphological characters that might be used? Burger *et al* (1950) pointed out

1. Also, Executive Director, Highlands Biological Station.

in their work on *Eurycea* that natural populations may differ in internal anatomical, physiological, or cytological characters. How much individual variation is there in each of these *jordani* populations? The *melaventris* population for example was originally described as being without significant variations, and yet Howell and Hawkins (1953) found very significant variations in topotypic material. Mayr (1942) pointed out that subspecies should differ in physiological characteristics. Pigmentation is a diagnostic character in this group of salamanders, and pigment formation is a physiological process susceptible to temperature influence. This should be measured. Dunn (1940) reported that geographical races of *A. tigrinum* differ in physiological traits. And finally, the life histories of these *jordani* salamanders are unknown. We know nothing of the courtship pattern, egg laying, embryonic development, growth rates, etc. All of these problems would shed light on the nature of the speciation problem. We have witnessed a period in which energies have been directed towards naming new subspecies. We should enter a period in which the populations are fully characterized along lines of investigations that will contribute to an understanding of the nature of geographic variation.

The ecologist might investigate with profit the matter of range restriction in *clemsonae* and *shermani*. What ecological factors have operated to restrict these populations? Moisture? Temperature? Food? Or, relation to other organisms?

What can the geneticist do? Not a great deal of work has been published on chromosome number. How many of the variants in the *jordani* population are genetic? Are the red cheeks of *jordani* and the red legs of *shermani* genetic or are they phenotypic responses to specific environmental conditions?

These, then, are some of the problems dealing with one small group of animals that could well claim the attention of investigators. The Highlands Biological Station is strategically located for this work. Seven colleges and universities—Duke, North Carolina, North Carolina State, Georgia, Tennessee, Vanderbilt, and Wesleyan—support this regional station, along with over 200 lay members and professional biologists. Friends of the Station have made research funds available to support worthy and deserving projects that may be conducted at the Station. Facilities are adequate and living conditions pleasant. The Station is at the service of interested investigators.

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THE 31ST ANNUAL MEETING OF THE ACADEMY

The Georgia Academy of Science will hold its 31st Annual Meeting at North Georgia College, Dahlonega, on April 23-24, 1954. Dr. J. D. Anthony, of North Georgia College will be in charge of local arrangements. The section chairmen will send out notices soon regarding the program with a request for papers to be read at the meeting. Make your plans now to attend and participate in the meeting. Your work and your ideas are of interest to some one and will be of most service if made known to others.

NOTES AND NEWS

During the past summer Dr. W. B. Baker, Professor of Biology, Emory University, gave a course in the Morphology and Taxonomy of Spermatophytes at the Mountain Lake Biological Station of the University of Virginia.

Dr. W. H. Jones, Professor of Chemistry, Emory University, spent the summer at the Oak Ridge National Laboratory doing research on chemical problems related to nuclear studies.

Dr. Andrew Robeson joined the staff of the physics department of Emory University in June 1953. Dr. Robeson received his degree from the University of Virginia. His research was on an interferometric method for determining molecular weights with an ultracentrifuge. This method is especially applicable to molecular weight determinations within the range of 300 to 10,000.

Mr. R. H. Rohrer, Assistant Professor of Physics, Emory University, spent the past summer at Duke University as Research Associate with the Van de Graaff Research group investigating capture cross sections.

The Office of Ordinance Research, U. S. Army, has renewed for the current year the sponsorship of the research program in microwave spectroscopy at Emory University being directed jointly by Dr. J. W. Simmons of the Department of Physics and Dr. J. H. Goldstein of the Department of Chemistry.

At the Annual Meeting of the membership of the Highlands Biological Station on August 30, the Board of Trustees presented a Citation of Merit to Thelma Howell, Executive Director of the Station, for distinguished and meritorious service as Trustee Director of the Laboratory, and Executive Director of the Station. Dr. Lewis Anderson, Duke University, President of the Station, made the presentation.

Dr. W. B. Burbanck, Professor of Biology, and Dr. A. C. Clement, Associate Professor of Biology, Emory University spent the summer at the Marine Biological Laboratory at Woode Hole, Massachusetts continuing research they have had in progress there for several years.

Several new members have been taken into the Academy since publication of the directory in the previous issue. A supplementary list including all new members will be published in the next number of the Bulletin. Help the Academy to grow by recommending your friends for membership.

RESARCH FUNDS AVAILABLE

Funds in the amounts of $370.00 are available for grants for research to members of the Academy. In general the Academy Grants have ranged in amounts between $25.00 and $150.00. Applications in triplicate should be sent to the president or to the secretary. The application should give the name and position of the applicant, the amount requested, the estimated time required to complete the work the title of the contemplated project and a brief outline of the proposed work not to exceed 300 words. The awarding of the grants is in the hands of the research committee and applications will be considered in the order in which they are received.

It is recommended that the results of the research carried out with the aid of the grants be published in a scientific journal. A footnote giving credit to the Georgia Academy of Science for financial aid will be appreciated, should the work be published. The editor of the Bulletin will be glad to consider articles for publication that may result from the work done under the Academy grants.

TWO YEARS OF LICENSING PSYCHOLOGISTS IN GEORGIA

A. S. Edwards
University of Georgia

The State Board of Psychological Examiners has completed two years of work under the law for licensing Applied Psychologists. In all, sixty-four psychologists have met the requirements of the law and have been issued licenses for private practice in the state.

Many problems have been studied during this period. In its pioneer work the Board has had most gracious cooperation on the part of the Joint Secretary of the State Examining Boards, Mr. R. C. Coleman and from members of his staff. The issuance of licenses was necessarily in comformance with the law, and on many problems valuable help was

sought and received from an experienced judge whose services were given to the Board freely.

Antagonisms which have been reported in other states, have not been manifest in Georgia. Good will and cooperation have been accorded uniformly by members of other professions. Cordial encouragement has been offered by many members of the medical profession, and excellent cooperative working relations have been built up between psychologists and psychiatrists in many places.

The period during which the grandfather clause was in effect has expired and from now on, all applicants for license will be required to take examinations for licenses. Also, the requirements with respect to training will, in general, be higher.

APPLIED PSYCHOLOGISTS LICENSED BY THE GEORGIA STATE BOARD OF EXAMINERS OF PSYCHOLOGISTS, 1951-1953

Anderson, Mrs. Eddie Neely, Ed.D. ..... 1035 Juniper St., N.E., Atlanta
Marriage, family relations.

Baggs, Robert Edwin ..... 283 Taylor St., Savannah
Children, adults, psychotherapy, psychodiagnosis.

Blanks, James Bailey ..... LaGrange College, LaGrange
Consulting, students, adults, veterans.

Bolton, Euri Belle, Ph.D. ..... G.S.C.W., Box 97, Milledgevilie
Consulting, children.

Bortner, Rayman Winfield, Ph.D. ..... Veterans Hospital, Augusta

Broxson, John Alfred, Ph.D. ..... 933 Piedmont Ave., Atlanta
Testing infants, children; learning disabilities, infants, children.

Bryan, Laurence Leonard ..... 207 East Lake Ter., S.E., Atlanta
Personality; hypnotherapy.

Calhoon, Clair Henry, Ph.D. ..... U. S. Public Health Service, Atlanta

Carroll, Robert Paris, Ph.D. ..... State Dept. of Health, Div. Mental Hygiene, State Office Bldg., Atlanta
Consulting, general.

Cobb, Jacob Ernest, Ph.D. ..... 331 N. 7th St., Terre Haute, Ind.

Cox, Mrs. Myrtie ..... 765 Peeples St., S.W., Atlanta
Counseling, personal, educational, vocational.

Cranford, Peter Gordon, Ph.D. ..... P.O. Box 2012, Augusta
Referrals from Physician.

Edwards, Austin Southwick, Ph.D. ..... 190 Woodlawn Ave., Athens
Consulting.

Edwards, William Way, Jr. ..... 896 Virginia Circle, N.E., Atlanta
Testing and educational counseling.

Enneis, James M. ..... State Hospital, Milledge
Therapy, testing, psychodrama.

Felts, Mrs. M. Richard (Christine W.) ..... Consulting Psychologists, Inc., 805 Peachtree Bldg., Atlanta
Educational and vocational counseling.

Fretwell, Mary ..... State Hospital, Milledgeville

Freymann, Grace Marie ..... Warm Springs Foundation, Warm Springs
Counseling, therapy, vocational, educational guidance; polio patients.

Glickman, Albert S., Ph.D. ..... 245 Broadway, Newport, R. I.

Greene, James Edward. Sr., Ph.D. ..... 105 Peabody Hall, U. of Ga., Athens
Consulting, clinical, industrial.

Harvey, Lenore M.—512 S. McDonough St., Decatur
Vocational counseling and personal adjustment.

Heyer, Albert William, Jr., Ph.D.—525-805 Peachtree Bldg., Atlanta
Consulting, business, industry.

Highsmith, Mrs. E. M.—1393 Edgewood Ave., Macon
Teacher, Bibb Co. Schools: Private cases referred by teachers or parents.

Hinrichs, William Ernest, Ph.D.—2075 Ridgewood Dr., N.E., Atlanta

Hinton, Ralph T. Jr., Ph.D.—805 Peachtree Bldg., Atlanta
Analytic therapy, diagnostic evaluation.

Hughes, Robert Moore, Ph.D.—Consulting Psychologists, Inc., 805 Peachtree Bldg., Atlanta
Private practice: diagnosis, psychotherapy, children, adults.

Janus, Sidney Quentin, Ph.D.—Suite 420, 805 Peachtree Bldg., Atlanta
Industrial relations.

Johnson, Granville B. Jr.—Emory University, Emory Univ., Ga.
Vocational, business, educational, testing, diagnosis, evaluation, guidance.

Jost, Hudson, Ph.D.—Psychology Dept., Meigs Hall, U. of Ga., Athens
Educational, experimental, clinical; EEG.

Jourard, Sidney Marshall, Ph.D.—Dept. of Psychology, Emory University, Emory Univ., Ga.
Therapy, psychodiagnostics, vocational guidance.

Kelley, Miss Helen—312 Huntington St., Savannah
Testing and interpretations, four months up; referrals of children.

Koch, Ruth Mae—Smith High School, 535 Hill St., S.E., Atlanta

Kraft, Jack A., Ed.D.—839 Cardova Dr., N.E., Atlanta
Management selection coordinator, Lockheed Aircraft Corp.

Levin, Allen Ruskin—Box 67, V.A. Medical Teaching Group Hospital, Memphis 15, Tenn.
Neuropsychiatric: psychotic, psychoneurotic, behavior, speech, school problems.

Loveland, Edward H., Ph.D.—Dept. Psychology, Ga. Inst. Technology, Atlanta
Industrial consulting; employee selection, training and merit rating.

Lowe, William Robert, Jr.—569 Candler St., N.E., Atlanta
Vocational, veterans.

Martin, Brunson Wilkes—Asst. Field Director, American National Red Cross, Camp Gordon, Ga.

Martin, Harry, Ph.D.—VA Regional Office, 105 Pryor St., Atlanta

Martin, Hermon Wilkes, Ph.D.—Fishburne Bldg., Emory Univ., Ga.
Personality diagnosis and adjustment, children, adolescents, adults.

McCurry, William Hamilton—1315 D Park Ave., S.E., Atlanta
Child guidance.

McMahon, Ottis K., Ph.D.—1594 Doncoster Dr., N.E., Atlanta
Consulting for management.

Menius, Leonard Carey—706 East 57th St., Savannah
Industrial relations: testing and personnel research.

Moore, Joseph E., Ph.D.—268 Ponce de Leon Ave., N.W., Atlanta
Industrial guidance and executive evaluation.

Muthard, John Edward, Ph.D.—Dept. of Psychology, Emory University, Emory Univ, Ga.
Vocational counseling and Industrial consulting.

Osborne, Robert Travis, Ph.D.—Guidance Center, U. of Ga., Athens
Educational and vocational guidance; diagnostic testing, children, adults.

Overall, Mrs. Lucille C.—P.O. Box 1541, Savannah
Testing and vocational counseling; students, adults.

Papas, Aris Tally—224 Capitol Ave., S.W., Room 133, Atlanta
Child guidance.

Patton, Wendell M., Ph.D.—3182 Peachtree St., Atlanta 5
Management consultant: industry and government.

Poetter, Louis Jerome—Fulton County Juvenile Court, 183 Central Ave., Atlanta
Diagnosis and psychotherapy: children, adolescents, adults.

Pope, Henry Louis, Jr., Ph.D.—Southern Finance Bldg., Augusta
Psychodiagnostic testing, psychotherapy: referred private patients and veterans.

Riopelle, Arthur J., Ph.D.—15 Andrew Circle, N.E., Emory Univ., Ga.

Ross, Laurence Wilson—512 E. 56th St., Savannah
Personnel analyst; industrial.

Rowell, John Thomas—Milledgeville State Hospital, Milledgeville
Clinical: testing and therapy.

Smith, Marion Floyd—Box 1791, F.S.U., Tallahassee, Fla.
DNA.

Swartzlander, Earl Eugene, Ph.D.—Roher, Hibler & Raplogle, Atlanta

Thoburn, Isabella, Ph.D.—Wesleyan College, Macon

Thompson, Dorothy—Armstrong Junior College, Savannah

Wade, Bailey M., Ph.D.—Apt. 728, Howell House, 710 Peachtree, N.E., Atlanta
Testing, evaluation of test results; interviews of job applicants.

Walker, May A.—481 Grant St., S.E., Atlanta

Wax, Charles—Child Guidance Center, Coop Bldg., Mercer University, Macon

Winter, Leopold, Ph.D.—2302 Kimberly Drive, Augusta
Projective techniques, individual and group psychotherapy, personality dynamics; hospital patients (veterans); private practice: children and adults by referral only.

Workman, William Gatewood, Ph.D.—Box 754, Davidson, N. Carolina

Wyatt, Harriet Christine, (See Felts)

Young, Florene M., Ph.D.—Psychology Dept., Meigs Hall, U. of Ga., Athens
Testing and psychotherapy: students especially; also children, adults.

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